MATHEMATICAL ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN RELATION TO THEIR TYPE OF SCHOOL, MATHEMATICAL ANXIETY AND PROBLEM-SOLVING ABILITY

SYNOPSIS OF THE THESIS

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DECLARATION

I hereby declare that the synopsis of the thesis entitled "**MATHEMATICAL ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN RELATION TO THEIR TYPE OF SCHOOL, MATHEMATICAL ANXIETY, AND PROBLEM-SOLVING ABILITY".** to be submitted for the partial fulfillment of the Degree of Doctor of Philosophy is my original work and the dissertation has not formed the basis for the award of any degree, diploma, associate ship or fellowship of similar other titles. It has not been submitted to any other University or Institution for the award of any degree or diploma.

Place: Chail Chowk.

Date: 01-04-2024

Signature of the Scholar

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Forwarded by: Concern Supervisor

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Date: 01-04-2024

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Dr. Sita Devi

CERTIFICATE

This is to certify that the synopsis of the thesis entitled, "**MATHEMATICAL ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN RELATION TO THEIR TYPE OF SCHOOL, MATHEMATICAL ANXIETY, AND PROBLEM-SOLVING ABILITY".** is an original piece of work done by Gian Singh under my supervision for the degree of Doctor of Philosophy, in Abhilashi University Chail-Chowk Mandi H.P. I also certify that this work has not been submitted to any other University for a Ph.D. degree.

Place: Chail Chowk

Date: 01/04/2024

1/04/2024

Signature of the Supervisor

Dr. Sita Devi

INTRODUCTION

Education is the process that contributes to the natural and harmonious development of man's innate powers. It brings about the complete development of man's individuality and helps him to adjust himself to his environment. Education modifies behavior and attitude in a way that is beneficial for society and the world. Today, 'Education for All' is the main objective of our education system. Education in general, is the fundamental right of every child, and mathematics in particular, is a compulsory subject in schools up to the secondary level. So, mathematics is an indispensable part of the curriculum. National Curriculum Framework (NCF-2005) stated, "Access to quality mathematics education is every child's right and it should be affordable and enjoyable to every child.

From ancient times to till date mathematics is regarded as a 'Queen of Sciences'. It implies that mathematics is the foundation of all scientific knowledge. This knowledge has brought about a tremendous increase in industrial and technological growth, which has not only affected the mode of living but also the thinking and culture. In our daily lives, we use many mathematical concepts. Mathematics imparts a system in life because it deals with numbers. Our life revolves around numbers, as we need mathematics right from the early morning to the end of the day.

Mathematics is a challenging and vibrant subject connected to the real world at every level. No sphere of life runs devoid of mathematics. Mathematics is a subject that is appreciated, admired, and held high by individuals. Mathematics provides a definite way of thinking. Children who study mathematics develop an attitude with which they learn to work systematically, regularly, and properly.

According to the National Education Policy, 1986, "Mathematics should be visualized as the vehicle to train a child to think, reason, analyze and articulate logically. Apart from being a specific subject, it should be treated as a concomitant to any subject involving analysis and reasoning."

Mathematics develops scientific attitudes and reasoning in the students. The knowledge of mathematics is an essential tool in our society (Baroody, 1987). It is a tool that can be used in our daily lives to overcome the difficulties faced by everyone (Bishop, 1996).

According to Locke, “Mathematics is the way to settle in the mind of children a habit of reasoning.”

According to Young, “Mathematics is the only subject that encourages and develops logical thinking. It enables the student to discriminate between essentials and nonessentials. Mathematics has an important place in the school curriculum. At the secondary school level, mathematics education is very helpful in developing creative thinking, self-confidence, and problem-solving habits in students.

1. MATHEMATICAL ACHIEVEMENT

Mathematical achievement plays a very important role in the attainment of the ideal of harmonious development of a student. Mathematical achievement refers to the degree or level of success or proficiency attained in some specific areas of mathematics and scores in mathematics obtained by a person.

Academic achievement has always been a crucial area of educational research. Academic achievement, in general, refers to the degree or level of success or proficiency attained in some specific area concerning scholastic or academic work. Academic achievement may be defined as excellence in academic disciplines, in class, and extracurricular activities. It includes excellence in behaviour, confidence, communication skills, abilities, punctuality, assertiveness, arts, sports, and culture. Academic achievement is a key mechanism through which adolescents learn about their talents, abilities, and competencies which are an important part of developing career aspirations (Lentet al. 2000).

1.1 Factors Affecting Academic Achievement

Many factors affect academic achievement viz. intelligence, personality, motivation, school environment, heredity, home environment, learning experiences at school, interests, aptitude, family background, socio-economic status of the parents, and many other factors. Different educationists classified factors affecting mathematical achievement in different ways.

Classifications of some educationists are as follows: Aggarwal et al. (1998) reported four main factors affecting academic achievements, which are given below with their sub-parts:

1) Affective factors: cognitive style, value, observance, self-efficacy, emotional maturity, attitude, adjustment, interest, need and curiosity.

2) Cognitive factors: ability, intelligence, creativity, problem-solving ability, reasoning ability, and learning rate.

3) School-related factors: type of school, school climate, teachers' personality, homework, alienation, teachers' expectation and attitude, training strategies, teachers' experience, medium of instruction, teacher's behavior and competency, and classroom environment.

4) Home-related factors: family size, birth order, socioeconomic status of the family, gender bias, parental involvement, parental support & deprivation, child reasoning practices, working networking, parental aptitude, and expectations.

Sharma (2016) stated that several factors are responsible for the high and low achievement of the students and these factors can be divided into three broad categories: psychological factors, environmental factors, and personal factors.

1) Psychological factors: Psychological factors include intelligence, learning ability, motivation, self-efficacy, learning styles, study skills, creativity, level of aspiration, self-concept, interest, etc.

2) Environmental factors: These factors are related to the surroundings and environment of the individual and include socio-economic status, educational system, family environment, value system, teachers' efficiency, evaluation system, school situation, and environment.

3) Personal factors: Under this category age, sex, genetics, and health may be included as influencing factors of academic achievement. These factors may affect academic achievement in both ways i.e. positively and negatively. Studies have shown that warm and affectionate behavior towards children leads to their higher achievement in school (Epstein 2000). So, in short, we can say that academic achievement means scores or marks gained by a student in all subjects in an academic year and mathematical achievement means scores or marks gained by a student in mathematics in an academic year.

2. PROBLEM-SOLVING ABILITY

“If I had 60 minutes to solve a problem, I’d spend 55 minutes defining it, and 5 minutes solving it.” (Albert Einstein)

Problem-solving has been observed as one of the principal causes of scholastic failure in areas of science such as mathematics, chemistry, and physics (Perez & Terragosa, 1983). Problem-solving ability is a complex cognitive ability that characterizes a human activity requiring intelligence. Problem-solving is the framework or pattern within which creative thinking and reasoning take place. From childhood, we actively solve problems that are presented to us by the world. By solving problems, we acquire information about objects, events, people, and ourselves and store it in our memory. This memory helps us to solve further problems in our daily life at school, workplace, playground, etc. Every person has problem-solving ability which is used to find out the solution to problems. The term ‘problem-solving ability’ refers to the self-initiated cognitive behavioral process by which a person attempts to identify, discover, or invent effective or adaptive strategies for coping with problems in everyday living.

In the view of Gardener (1985), "Problem-solving involves a series of mental computations, so a theory of problem-solving must specify the specific mental process used to solve a problem as well as the methods that problem solvers employ for selecting and controlling their cognitive process."

2.1 Types of problem-solving ability

There are two major types of problem-solving ability: 1) Social problem-solving ability and 2) Mathematical problem-solving ability

1) Social problem-solving ability:

In our day-to-day social life viz: at our home, playground, workplace, etc. we face many problems and to solve these problems we use social skills. These social skills help us to solve difficult problems in our lives. Social problem-solving ability consists of two major components:

a) Problem orientation

b) Problem-solving skills

a) Problem orientation: Problem orientation is the motivational component of problem-solving ability. Moreover, it is a generalized cognitive behavioral response set that a person brings to a new problem situation and it results primarily from past problem-solving experiences. The problem orientation component of problem-solving ability does not include the specific cognitive and behavioral skills that are necessary for effective problem-solving in a specific situation. But it includes general cognitive and behavioral skills which are used in our general problematic situation.

b) Problem-solving skills: The problem-solving skills component of social problem-solving ability consists of four specific goal-directed tasks that enable a person to solve a particular problem successfully and these are given below:

I. Problem definition and formulation

II. Generation of alternative solutions

III. Decision-making

IV. Solution implementation and verification

2) Mathematical problem-solving ability:

Problem-solving ability in mathematics is perhaps one of the most difficult abilities for students to develop. It takes practice and many students are easily frustrated when they don't see a solution to a problem right away. The mathematical problem-solving ability also has two major components. a) Understanding problems b) Problem solving skills.

a) Understanding problems: Understanding problems is the basic component of mathematical problem-solving ability. In mathematics students usually have word problems. They have problems understanding mathematical problems. For the solution to this type of problem, read the problem several times so that you get what's going on with the problem.

b) Problem-solving skills: Problem-solving skills are based on reasoning ability. Problem-solving skills make a person able to compute problems. In social problems, we have many solutions to a problem but in mathematical problems, we have only one solution to a problem. So, mathematical problem-solving skills are very specific. Different individuals may show different strengths and weaknesses in these major components of mathematical problem-solving ability.

Moreover, these components may be equally important for all types of problems (e.g. simple versus complex).

2.2 Characteristics of a good problem solver:

Problem-solving is a skill everyone uses throughout life. Good problem solvers know the anatomy of a problem. They know that a problem contains facts, a question, and a setting. Problem solvers are extremely perseverant when solving problems.

Dowshen in 1980 gave some characteristics of an effective problem solver which are given below:

1) Tends to use a wide range of heuristic strategies

2) Seems to follow some pattern when solving a problem and exhibits trial and error ability.

3) Has good arithmetic skills

4) Has confidence in his mathematical ability

5) Tends to check answers for reasonableness and can estimate an answer

6) Usually obtains an understanding of a problem before trying to solve it.

Problem-solving ability plays an important role in the subject of mathematics. In mathematics all the exercises are based on problem-solving ability, without this ability, nobody can perform well in mathematics. Gick (1986) and Jonassen & Henning (1999) expressed that problem-solving depends on conceptual knowledge and procedural knowledge available to the learner. Students without conceptual knowledge of the subject matter will find it difficult to solve problems. Both the problem-solving skills of an individual and the learning of contents are interrelated with each other. Problem-solving skills promote learning.

NATIONAL CURRICULUM FRAMEWORK (2005) suggested that an attempt has been made to allow multiple ways of solving problems and encouraging children to develop strategies different from others. There is an emphasis on working with basic principles rather than on memorization of algorithms and shortcuts. NCF-2005 stressed that learning mathematics is not about remembering solutions or methods but knowing how to solve problems. Problem-solving strategies provide learners opportunities to think rationally, enabling them to understand and create methods as well as processes- and become active rather than passive receivers. Learners need to identify and define a problem, select or design possible solutions, and revise or redesign the steps

if required. NCF-2005 also pointed out that the role of a teacher gets modified to that of a guide and facilitator. Students need to be provided with activities and challenging problems, along with sets of many problem-solving experiences.

Problem-solving ability is the basic requirement to solve mathematical problems. Hence, there is a significant relationship between mathematical achievement and problem-solving ability (Bhat, 2014). Problem-solving in mathematics requires an ability to understand mathematical ideas and apply them in a variety of situations.

2.3 MATHEMATICAL ANXIETY

Mathematical anxiety is described as a feeling of tension that interferes with the manipulation of mathematical problems in a wide variety of ordinary life and academic situations. Mathematical anxiety is a phenomenon that is often considered when examining students' problems in mathematics. It can also be called mathematical phobia. Mathematical anxiety is often defined as a feeling of tension, apprehension, or fear that interferes with one's performance in math (Ashcraft, 2002).

Freud (1949) was the first person who describe the meaning of anxiety in the context of psychological theory; he singled out anxiety as a crucial problem of emotional and behavioral disorders. According to Freud, anxiety controls our behavior by causing us to avoid threatening experiences in the environment. Anxiety is one of the most pervasive psychological phenomena of the modern era and refers to a persistently distressing psychological state arising from an inner conflict.

According to Cattell (1966), anxiety is a function of the magnitude of all unfulfilled needs and the degree of uncertainty that they will be fulfilled, or more simply stated, anxiety corresponds to uncertainty of rewards or total need fulfillment.

Mathematical anxiety is a state of a feeling of sinking, uncertainty, and despair at doing arithmetic and mathematics. Mathematical anxiety is an important factor that affects students' achievement and attitude towards mathematics (Hembree, 1990). Mathematical anxiety is composed of two components: an affective and a cognitive component. While the affective

component relates to perceptions of ability and performance, the cognitive component relates to the perceived importance; the affective component relates to the perceptions of ability and performance, and the cognitive component relates to the perceived importance and efforts involved in learning and using mathematics (Wigfield and Meece, 1988).

4. REVIEW OF RELATED LITERATURE:

Gupta (2013): studied the interactional effects of Sex and Caste on the problem-solving ability and academic achievement of students. The results revealed that Sex and Caste had a significant impact on the problem-solving ability of students. Sex had no significant impact on the academic achievement of students. Caste had a significant impact on the academic achievement of students. However, no interactional effect of sex and caste was found on the problem-solving ability and academic achievement of students.

Singh (2013): explored the effects of gender, attitude towards mathematics, socio-economic status, use of computers, television watching, school type, school climate, and medium of instruction on mathematics achievement. The results of the study revealed that there was a significant difference between the mathematics achievement of boys and girls. Moreover, the students of central government schools and privately managed schools had higher mathematics achievement in comparison to minority-managed schools and state government schools.

Nidhi and Singh (2014): studied problem-solving ability and attitude towards mathematics as predictors of mathematical achievement. The results of the study showed a significant positive relation between problem-solving ability & mathematical achievement and between attitude towards mathematics & mathematical achievement. The prediction of mathematical achievement based on problem-solving ability and attitude toward mathematics was significant.

Khatun (2014): Studied Family Climate and Achievement in Mathematics of Students at Secondary Level. The findings showed that the achievement of boys in mathematics was higher than girls. No significant differences were found in mathematics achievement, according to the three different levels of family climate.

Pandey (2017): studied the mathematical achievement of X-class students of Secondary School of Bageshwar District. The result of the study found that there is a significant difference between the mathematical achievements of class X students of secondary schools based on their sex and social belongingness however it is interesting to know that rural male and urban male students are almost similar in their mathematical achievement scores.

Kundu and Kar (2018): conducted a study the mathematics anxiety and its relationship with the achievement of secondary school students. The Results of the study revealed that gender doesn't affect anxiety towards mathematics between boys and girls students and rural students are significantly more math anxious than urban students.

Yadav and Singh (2018): examined the relationship between achievement in Mathematics and Mathematics anxiety among secondary school students. It was found that a significant difference was observed between the Mathematics achievements of high and low-anxious students. It was also noted that the difference in Mathematics anxiety between male and female students was not significant at a 0.05 level of significance.

Mandal (2019): In this study, the researcher wanted to find out the mathematics anxiety and Prevention Strategies. The results revealed that there were significant differences in mathematics anxiety and performance in mathematics on gender and type of schools but there is no significant difference between habitat in mathematics anxiety and performance in mathematics.

Midhundas (2019): examined Mathematical Problem-Solving Ability and Mathematics Anxiety The results revealed that, students with Mathematics Anxiety perform poorly in tests on Mathematical Problem-Solving Ability, and hence those factors contributing to Mathematical Anxiety are minimized.

Kolhe (2021): examined the effectiveness of Self-Regulated Learning strategies to improve mathematics achievement. The findings of the study reflected that the Self-Regulated Learning Strategy was effective in terms of the students' Achievement in Mathematics. A significant effect of Treatment, Intelligence, and Level of Study Habits was found on the student's

Achievement in Mathematics. A significant effect of Treatment was also found on the Problem-Solving Ability of students. The results of the study also revealed that there was no significant effect of Gender on the student's Achievement in Mathematics and Problem-Solving Ability of students. There is no significant effect of Intelligence was also found on the Problem-Solving Ability of students. There was no significant effect of Treatment and Gender was found on the Attitude towards Mathematics of high school students.

Maamin, Maat, and Iksan (2022): found Student engagement is a multidimensional construct that predicts learning performance. However, student engagement receives limited attention, especially in mathematics. The findings of the study indicated that there is a significant relationship between cognitive engagement, affective engagement, behavioral engagement, and mathematical achievement.

Venkatarao (2022): attempted to assess the mathematical achievement of 10 class pupils in the Srikakulam district of Andhra Pradesh. The study revealed a substantial difference in the performance of class 10 students in secondary schools in Mathematics in relation to gender, location of the school, and type of school management. The students' achievement in rural schools has been observed lower than that of studying in urban schools. The results also revealed that government school students have exhibited lower achievement in mathematics than those studying in private schools.

Shagun (2022): studied Problem problem-solving ability of Adolescents in Relation to Gender, Area, and Type of School in Hamirpur District. The results revealed that the girls possessed higher levels of problem-solving ability as compared to boys. The findings of the study also revealed that adolescents who belong to rural areas and private schools possessed higher problem-solving abilities.

Sangral and Kumar (2023) observed that gender does not affect the mathematical test anxiety of secondary school students. it indicates that the level of mathematical numerical anxiety is significant among boys and girls secondary school students. Therefore, it can be interpreted that gender affects the mathematical numerical anxiety of secondary school students. It is found there

is a significant difference in the numerical anxiety of secondary school students with regard to their locality. Hence, it may be pointed out that locality may affect the mathematical numerical anxiety of secondary school students. The study found that there is no significant difference in the mathematical anxieties of secondary school students with regard to their type of schools. Thus, it can be concluded that the numerical anxiety of government and private secondary school students was found to have no significant difference. Therefore, it can be interpreted that the school types do not affect the numerical anxiety of secondary school students.

Shah et. Al. (2023): examined the effect of students' attitudes on mathematical achievement has gathered tremendous attention from various researchers. It was concluded from the study that attitude had an impact on the mathematical achievements of the students. Parents' education, qualification, and social status had a positive effect on the academic achievements of students.

Rani and Rani (2024): suggested mathematics achievement of secondary school students is significantly influenced by various psychological factors, including intelligence, learning habits, motivation, concentration, self-confidence, and academic stress. Among these factors, mathematical anxiety stands out as a crucial element, characterized by feelings of tension and apprehension. This anxiety can lead to boredom with mathematics, especially during middle school, and can result in low confidence among students, even at the primary school level. Understanding and addressing mathematical anxiety is essential to improve students' achievement in mathematics. Teachers play a vital role in helping students overcome mathematical anxiety through improved teaching methods that encourage students and make mathematics more engaging.

5. NEED AND SIGNIFICANCE OF THE STUDY

The study of mathematics develops the ability of critical thinking and reasoning. The present era is called the age of science and information technology. NCF-2005 points out that the aim of learning mathematics is not merely being able to develop abilities in the child that would improve her/his relationship with the world. The NCF-2005 also emphasizes development in the

children of logical abilities as well as abilities to comprehend space, and spatial transformation and develop the ability to visualize both these. It recommends that mathematics needs to move slowly towards abstraction even though it starts from concrete experiences and models. Problem-solving is considered the heart of mathematics learning because the skill is not only for learning the subject, but it emphasizes developing skills in thinking as well. Students can apply their knowledge and problem-solving skills to be useful in daily life since the processes of solving mathematical problems are similar to general problem-solving.

The present research lies in the exploration of how different types of secondary schools impact students' mathematical achievement. Understanding these variations is crucial for policymakers seeking to promote educational equity and access. By identifying disparities in mathematical achievement across public, private, charter, and specialized schools, policymakers can tailor interventions and allocate resources more effectively to ensure all students receive quality math education, regardless of school type.

In addition to school type, the study considers the role of mathematical anxiety—an often overlooked yet pervasive barrier to mathematical success. Mathematical anxiety can significantly hinder students' confidence and performance in mathematics, affecting their overall academic trajectory. By examining how mathematical anxiety interacts with school type and its impact on mathematical achievement, the research sheds light on the psychological factors influencing student learning outcomes. This understanding can inform the development of targeted interventions and support services to help students manage anxiety and cultivate a positive mindset toward mathematics.

Furthermore, the inclusion of problem-solving ability as a focal point of the research enriches its significance. Problem-solving skills are not only essential for academic achievement but also for success in various facets of life. By investigating how problem-solving ability relates to school type and mathematical anxiety, the study provides valuable insights into factors that contribute to students' overall mathematical proficiency and readiness for real-world challenges. This understanding can inform curriculum design and instructional practices aimed at fostering critical thinking, creativity, and resilience in mathematical problem-solving.

Moreover, the research contributes to the broader discourse on mathematics education and student well-being. By examining the complex interplay between school type, mathematical anxiety, problem-solving ability, and mathematical achievement, the study offers a nuanced understanding of the factors shaping students' experiences and outcomes in mathematics. This holistic perspective can guide educators, policymakers, and parents in creating supportive learning environments that promote students' academic success and socio-emotional well-being.

The implications of this research extend beyond academia to impact real-world educational practices and policies. Educators can use the insights gained to tailor instruction and support services to meet the diverse needs of students, fostering a positive learning environment conducive to mathematical success. Policymakers can leverage the findings to advocate for equitable educational opportunities and allocate resources strategically to address achievement gaps. Parents can gain valuable information to make informed decisions about their children's education and support their mathematical development at home.

During the last few decades, mathematical achievement, problem-solving ability, and mathematical anxiety of students have assumed great importance in the field of education. How to increase their mathematical achievement, and problem-solving ability, and how to reduce mathematical anxiety, these are important questions before educationists, policymakers, curriculum planners, and researchers. Therefore, to analyze critically these issues, the investigator became interested in undertaking the present study. The focus of the proposed study is to explore the impact of mathematical achievement in relation to mathematical anxiety and problem-solving ability of secondary school students. It is evident from the above-mentioned studies that various studies have been conducted on mathematical achievement with regard to different related variables but there is a dearth of studies in the field of mathematical achievement with relation to type of school, mathematical anxiety, and problem-solving in India. As regards the criterion of originality of the problem, the available survey and sources of research were reviewed. The investigator did not find any study in tandem with these four variables viz. mathematical achievement, type of school mathematical anxiety, and problem-solving ability at the particularly secondary stage. So, the investigator feels the need to conduct the study on secondary school

students on these variables i.e., mathematical achievement, mathematical anxiety, and problem-solving ability.

In conclusion, the research on the "Mathematical Achievement of Secondary School Students in Relation to Their Type of School, Mathematical Anxiety, and Problem-Solving Ability" holds immense significance for education stakeholders striving to enhance students' mathematical proficiency, confidence, and overall well-being. By addressing key factors influencing mathematical achievement, the study contributes to efforts to promote educational equity, excellence, and empowerment for all students. On this account, the present study has been taken by the investigator.

6. STATEMENT OF THE PROBLEM:

MATHEMATICAL ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN RELATION TO THEIR TYPE OF SCHOOL, MATHEMATICAL ANXIETY AND PROBLEM-SOLVING ABILITY

7. OBJECTIVES OF THE STUDY:

The following objectives have been formulated for the present investigation:

1. To Study the Levels of Mathematical Achievement of secondary school students.
2. To study the relationship between mathematical achievement and mathematical anxiety of secondary school students.
3. To study the relationship between mathematical achievement and problem-solving ability of secondary school students.
4. To study the mathematical achievement of secondary school students in relation to their Gender and Type of school.
5. To study the interactional effect of Gender, and type of school on Mathematical Achievement of secondary school students.
6. To study the mathematics achievement of secondary school students in relation to their gender and mathematical anxiety.

7. To study the interactional effect of gender and mathematical anxiety on the Mathematical achievement of secondary school students.
8. To study the mathematical achievement of secondary school students or in relation to their type of school and mathematical anxiety.
9. To study the interactional effect of type of school and mathematical anxiety on the Mathematical achievement of secondary school students.
10. To study the mathematical achievement of secondary school students in relation to their gender and problem-solving ability.
11. To study the interactional effect of gender and problem-solving ability on the mathematical achievement of secondary school students.
12. To study the mathematical achievement of secondary school students in relation to their type of school and problem-solving ability.
13. To study the interactional effect of type of school and problem-solving ability on the mathematical achievement of secondary school students.
14. To study the interactional effect of mathematical anxiety and problem-solving ability on the mathematical achievement of secondary school students.

8. HYPOTHESES OF THE STUDY

1. There will be no significant correlation between mathematical achievement and mathematical anxiety of secondary school students.
2. There will be no significant correlation between mathematical achievement and the problem-solving ability of secondary school students.
3. There will be no significant differences in the Mathematical Achievement of secondary school students in relation to their gender and type of school.
4. There will be no significant interactional effect of gender and type of school on the Mathematical Achievement of secondary school students.
5. There will be no significant differences in the Mathematical Achievement of secondary school students in relation to their gender and mathematical anxiety.

6. There will be no significant interactional effect of gender and mathematical anxiety on the Mathematical Achievement of secondary school students.
7. There will be no significant differences in the Mathematical Achievement of secondary school students in relation to their type of school and mathematical anxiety.
8. There will be no significant interactional effect of type of school and mathematical anxiety on the Mathematical Achievement of secondary school students.
9. There will be no significant differences in the Mathematical Achievement of secondary school students in relation to their gender and problem-solving ability.
10. There will be no significant interactional effect of type of gender and problem-solving ability on the Mathematical Achievement of secondary school students.
11. There will be no significant differences in the Mathematical Achievement of secondary school students in relation to their type of school and problem-solving ability.
12. There will be no significant interactional effect of type of school and problem-solving ability on the Mathematical Achievement of secondary school students.
13. There will be no significant interactional effect of mathematical anxiety and problem-solving ability on the Mathematical Achievement of secondary school students.

9. DELIMITATIONS OF THE STUDY

The present study will be delimited in its scope to the following features:
1. The present study will be confined to three districts i.e., Mandi, Hamirpur and Kullu districts of Himachal Pradesh only.

2. The study will be delimited to secondary school students of government and private schools affiliated to Himachal Pradesh Board of School Education, Dharamshala only.

10. OPERATIONAL DEFINITIONS OF TERMS USED

1. Mathematical Achievement: Mathematical achievement refers to the level of proficiency demonstrated by secondary school students in understanding, applying, and solving mathematical concepts, problems, and tasks. This includes their ability to comprehend

mathematical principles, perform calculations accurately, solve mathematical problems efficiently, and demonstrate conceptual understanding across various mathematical topics and domains, as assessed through standardized tests, classroom assessments, grades, and teacher evaluations.

2. Secondary School Students: refers to students who are attending a school that offers a secondary curriculum, usually for grades 9 through 12.

3. Gender: refers male and female studying in secondary classes.

4. Type of School: refers to Government and Private schools affiliated with HP Board of School Education Dharamshala.

5. Mathematical Anxiety: refers to the presence of physiological symptoms such as increased heart rate, sweating, or muscle tension, along with negative affective responses such as feelings of fear, worry, or tension specifically triggered by mathematical tasks, tests, or situations.

6. Problem-solving Ability: defined as the capacity to analyze complex situations, identify relevant information and constraints, generate and evaluate multiple potential solutions, and select the most appropriate course of action to achieve a desired outcome.

11. METHODOLOGY

11.1 RESEARCH METHOD TO BE USED

Research Method is the procedure of research technique. It is the logic of scientific investigation. A systematic approach toward a particular phenomenon is called a method. The methodology used, in any investigation determines its testing.

For conducting the present investigation, a descriptive survey method of research will be used

11.2 SAMPLE/POPULATION

Population: In research, the term "population" refers to the entire group of individuals, items, or phenomena that meet specific criteria and are of interest to the researcher. This group represents the larger target audience from which the researcher draws conclusions or generalizations

It's important to note that the characteristics of the population influence the generalizability of research findings. Researchers often use sampling techniques to select a representative sample from the accessible population, with the goal of making valid inferences about the larger target population based on the characteristics of the sample.

Overall, understanding the population of interest is essential in research as it helps researchers define the scope of their study, identify the appropriate sampling frame, and make meaningful interpretations and generalizations of the study findings.

In the present study, all the students of 9^{th} class studying in government and private school affiliated to Himachal Pradesh Board of School Education (HPBOSE) Dharamshala.

Sample: A sample must be a true representative of the entire population and it must provide the whole information about the population. In the present study the investigator will use Multistage Random Sampling Technique.

There are twelve districts in the state of Himachal Pradesh which is subdivided in to three administrative divisions namely Mandi, Shimla and Dharamshala. The investigator will select division Mandi for the present study. Mandi division is comprising of five districts namely Bilaspur, Hamirpur, Mandi, Kullu, and Lahul & Spiti. Out of which investigator will be select three districts i.e., Mandi, Kullu, and Hamirpur randomly by using lottery method. The educational blocks of Mandi, Kullu and Hamirpur are 23, 06 and 06 respectively. Out of which investigator will select three educational blocks from Mandi and One educational block from each Hamirpur and Kullu district randomly. In the sampled educational blocks of district Mandi, Kullu and Hamirpur the investigator will select 25 government and 25 private schools from each selected educational block. further investigator will select 15 students from each selected school randomly by odd-even method.

11.3 RESEARCH TOOL TO BE USED

For the collection of data in the present study, the investigator will use the following research tool.

1. **Mathematical Achievement Test (MAT):** was developed and standardized by Dr. Imam and Khatoon (2012).
2. **Problem Solving Ability Test:** Problem solving ability test (PSAT) was developed and standardized by L. N. Dubey (2011).
3. **Mathematical Anxiety Scale:** Mathematical anxiety scale (MAS) was developed and standardized by Mahmood and Khatoon (2012).

11.4 VARIABLES OF THE STUDY

A variable is any characteristic, number, or quantity that can be measured or controlled and can vary or take on different values. Variables are essential components of research studies as they allow researchers to study relationships, test hypotheses, and draw conclusions. Only two types of following variables i.e., independent variables and Dependent variables are used in the present study.

Independent Variables:

- Gender
- Type of School
- Mathematical Anxiety
- Problem-Solving Ability

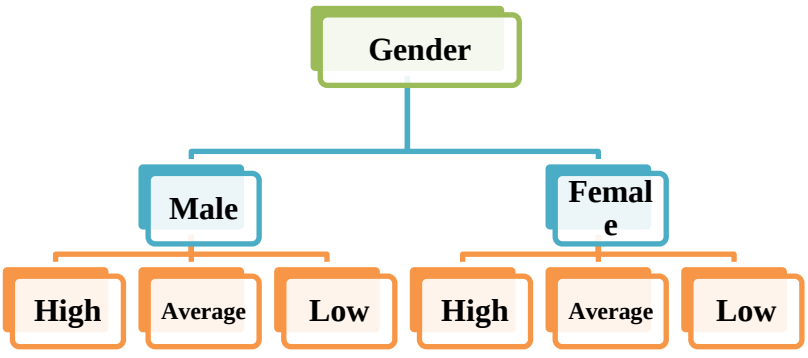
Dependent Variable:

- Mathematical Achievement

12. RESEARCH DESIGN OF THE STUDY:

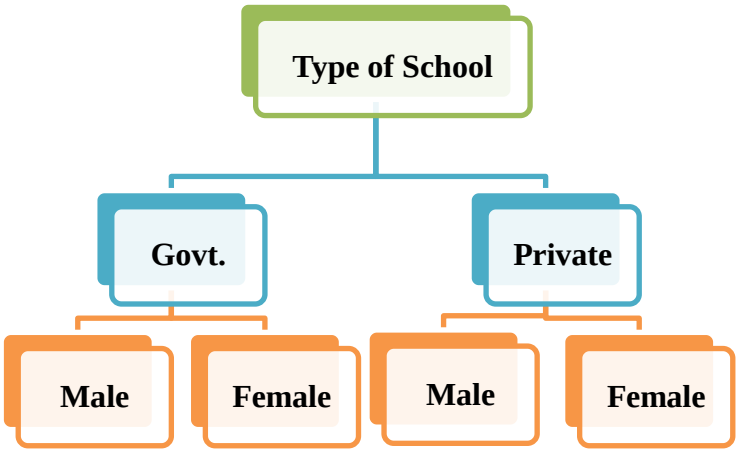
Gender X Mathematical Anxiety

(2x3 factorial Design)



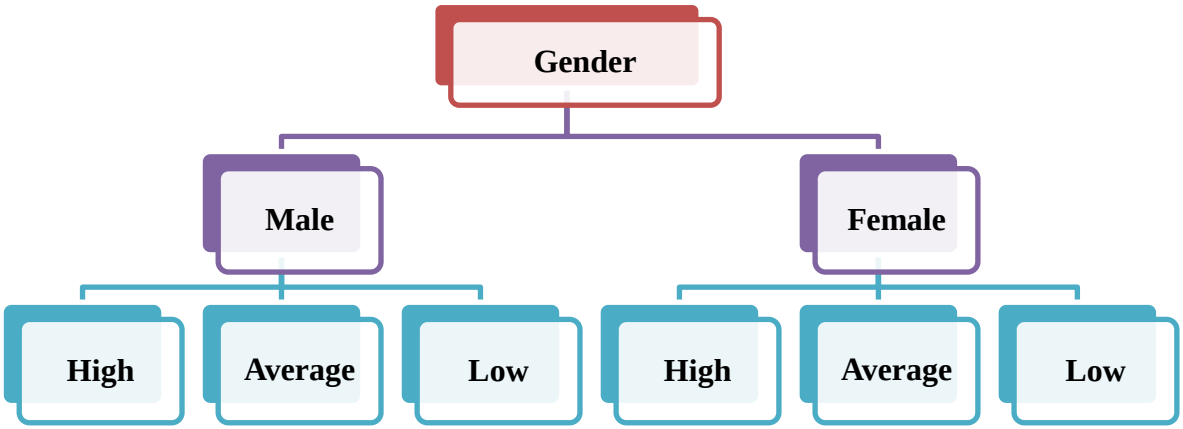
Gender X Type of School

(2x2 factorial Design)



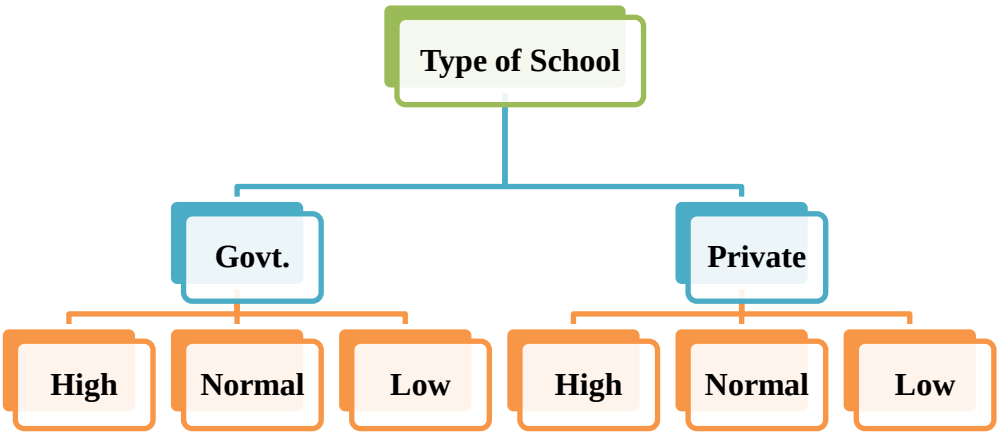
Gender X Problem Solving Ability

(2x3 factorial Design)



Type of School X Problem Solving Ability

(2x3 factorial Design)



14. STATISTICAL TECHNIQUES TO BE EMPLOYED

For achieving the objectives of the present study following statistical techniques will be used:

1. Descriptive statistics
2. Correlation (Pearson-R)
3. Analysis of Variance (Two-way ANOVA)

In order to study the nature of distribution of Mathematical Achievement scores of secondary school students, descriptive statistics like mean, median, mode, S.D., Q.D., skewness and kurtosis will be calculated. For studying the relationship between mathematical anxiety and problem-solving ability with mathematical achievement of secondary school students the correlation of Karl Pearson will be employed. For studying the gender-wise significance of the difference in the Mathematical Achievement scores of secondary school students, t-test will be used. Further for finding out the main effects of gender, type of school, mathematical anxiety and problem-solving ability along with their multiple interactional effect on Mathematical Achievement of secondary school students, the statistical technique of analysis of variance (two- way ANOVA) will be used.

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